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where  $\alpha, \beta, \gamma, \dots$  are the six different prime factors 2, 3, 5, 7, 31, 61 (with repetition 2 and 5) combined in products of 1, 2, 3, ..., 10 letters at a time.

By actual calculation and checking we have found the following ten solutions:

$$x = -3343, 12721, 320, 305, 7547, -2225, -710, -3215, -8495, -56950;$$

$$y = 2, 8, 29, 374, 4187, -1, -91, -1486, -4276, -29851;$$

$$u = 568, -2634, -116, 454, 5923, +337, -126, -2136, -6102, -42446;$$

$$v = -137, -89, -101, 319, 5473, -141, -261, -2121, -5841, -39941.$$

Also solved by G. B. M. Zerr.

169. Proposed by R. D. CARMICHAEL, Princeton University.

Let  $Q_n(x)=0$  be the equation whose roots are all the primitive  $n$ th roots of unity without repetition. In  $Q_n(x)=0$  replace  $x$  by  $\alpha/\beta$ , a fraction in its lowest terms, and clear of fractions. Let  $Q_n(\alpha, \beta)$  represent the resulting first member. Set  $n=mp$  where  $p$  is the largest prime factor of  $n$ . It is required to find all the integral values of  $\alpha, \beta, m, p$  satisfying the following relations:

$$(1) \quad Q_m p(\alpha, \beta) = p, \\ (2) \quad \alpha^m - \beta^m \equiv 0 \pmod{p}.$$

One such solution is:  $\alpha=2, \beta=1, m=2, p=3$ . (See MONTHLY, Vol. XII, p. 89.)

[No solution of this problem has been received.]

170. Proposed by PATRICK WALSH, 1451 Annunciation Street, New Orleans, La.

The areas of rectangles  $A$  and  $B$  are respectively 15170 10/27 and 31230.3627. Find the sides and diagonal of each rectangle in exact or rational numbers.

Solution by B. F. FINKEL, Ph. D.

For  $A$ , let  $x$  and  $y$  be the dimensions of the field. Then

$$xy = 15170 \frac{10}{27} = \frac{2^{14} \cdot 5^2}{3^3} \dots (1), \text{ and } \sqrt{x^2 + y^2} = d \dots (2),$$

where  $d$  is the diagonal, which is to be rational. Solving (1) for  $y$  and substituting the value thus found in (2) and reducing, we have

$$\frac{\sqrt{(3^6 x^4 + 2^{28} \cdot 5^4)}}{3^3 y} = d.$$

Let  $x = \frac{2^7 \cdot 5}{3^2} z$ . Then  $d = \frac{2^7 \cdot 5}{3^2 z} \sqrt{z^4 + 9}$ . Let  $\sqrt{z^4 + 9} = z^2 t - 3$ . Then  $z^2 = \frac{6t}{t^2 - 1}$ .